Pearson's plan of proving or disproving telegony by a statistical study of the degrees of resemblance of children to fathers rests more on mathematical ideas than on biological indications, to judge from Thompson's account of it.

I should not like to be responsible for any biologist's account of my work, and it was perfectly open to Mr. Cook, as Thompson presumably cites the locus of my memoir (*Royal Society Proc.*, Vol. 60, p. 273, 1896), to have consulted it, for he writes from Washington. However, he has not chosen to do so, and prefers to suggest that I have not done the very obvious thing to do, namely, compare maternal and paternal resemblances in the case of elder and younger children. I do not know whether a man makes himself ridiculous in the biological field when he criticizes another for not doing exactly what he has done, but I do know what we think of him in the sphere of the exact sciences!

Karl Pearson

SCIENTIFIC BOOKS

BAILEY'S CYCLOPEDIA OF AMERICAN AGRICULTURE

The twenty-five hundred two-column quarto pages of Bailey's "Cyclopedia of American Agriculture," recently from the press, mark a milestone in American agricultural thought. It is a compact library of scientific and usable fact and philosophy of country life in America. Volume I. passes in review the important agricultural features of the United States, her tropical possessions, Canada and Mexico, as seen by many independent observers. It deals with the interior of the farm as conditioned by its environment of soil and climate; with its development by capital and equipment into a source of profit; and with its sanitation and adornment as a place of abode. Volume II. deals with farm and field crops, their botany, their uses, their improvement by breeding, the introduction of better plants, the methods of growing and marketing crops, together with the manufacture and sale of crop products. Volume III. treats of animals, the history of the formation of breeds, the facts, philosophies and practise in animal breeding and animal feeding; the development of live stock products, the methods of preparing for the markets and marketing them. Volume IV. considers the more general matters of rural affairs; of the relations of the farm as a business entity to the world about, our national agricultural resources, the growth of agricultural wealth, machinery, city markets and other forces which impel the increase of agricultural production. Facts are given about land tenures; concerning labor; social, church and economic organizations, both cooperative and under the legal machinery of the state. Education for country life is dwelt upon, as also governmental aid by means of research institutions, and through police control as of fertilizers, feed stuffs, animal diseases and plant diseases.

To this encyclopedia more than a thousand technical agriculturists, general scientists and economists contributed articles or revised the work of others; and the text is illuminated with more than twenty-five hundred illustrations. The primary arrangement of the subject matter under a logical topical classification instead of the ordinary alphabetic arrangement of cyclopedia makes the book more readable and less a mere reference book. These books, at five dollars per volume, will in a way compete with correspondence courses in agriculture. The person who will read intelligently these four books will have absorbed a large part of the best knowledge of American agriculture, and he will find that henceforth he will read agricultural periodicals and technical bulletins and books on agriculture and country life with more discernment—and the farm boy who will read through the more interesting and vital parts of these volumes will enter upon the work of the agricultural school and agricultural college with an advantageous viewpoint not possessed by most of his fellow students. Model farm homes which have a group of boys in their teens will no doubt be the chief markets for these four books. These volumes, together with the bulletins and reports from departments of agriculture and experiment stations, form a splendid basis upon which to start the agricultural side of the farm family library.

These volumes offer the broadest and best general single exposition of the output of our

agricultural research and educational institutions. They form a good key to the body of knowledge already accumulated. They are in part history. Their substance gives prophecy of the greater things which are to come.

In another decade or two science will have not only doubled our definite knowledge of things agricultural, but will have reduced this body of thought to pedagogic form and will have secured it a place beside the three R's in our rural schools. Had these volumes been written two or three years later the author would have placed the consolidated rural school—the farm school out in the open country or in the village—foremost as an educational agency in country life. And the publishers will find that these rapidly multiplying schools, so organized as to support school and circulating libraries in the rural communities, will be one of their largest markets for sets of these volumes.

This encyclopedia will prove of especial value in the library of all secondary schools and colleges, whether patronized by city- or country-bred youth. It will be a source of information not only in regard to subject matter for use in class work—but as the basis of essays, debates and other literary efforts. The presence of this body of knowledge will make it possible for teachers to assign more written work on concrete subjects, that the pupils may devote the actual composition to writing facts, rather than to trying to dig up abstruse thoughts which do not exist in their minds. The opportunity afforded for our youth to know more not only of various aspects of outdoor life, but of our greatest industry and of our most numerous industrial class is important. Not only is it of advantage for city youth to have clear conceptions of farms and farmers, but it is important that country youth should know more of other farms and of the farmers of other communities.

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Zur Biologie des Chlorophylls. Laubfarbe und Himmelslicht. Vergelbung und Etiolement. Von E. STAHL, Professor in Jena. Jena, 1909.

Professor Stahl is one of the foremost botanists of that school of biologists which attempts to interpret the facts of nature on the hypothesis that everything which endures is useful, that the qualities of an organism which are useless or harmful presently disappear or cause the organism to disappear in the struggle for existence. In the present contribution to philosophical biology Stahl has selected for consideration a subject of prime importance: Why are plants green, why are the organs in which plants manufacture food from inorganic materials green?

It is remarkable that the plants of the earth's surface are green or have green leaves. Few land plants are otherwise colored; the plants living below low-tide mark are, generally speaking, red; many plants between the tide marks, or close to the surface of the sea, are more or less olive, that is, greenish-brown; a large group of more or less unicellular algæ, living on damp soil or in shallow water, both fresh and salt, are olive-brown. Certain bacteria, constituting a small group, are purplish-red. Green is, then, the predominant color of the vegetation of land and sea. And one is disposed to believe that this has always been the case since plants came into existence.

The manufacture of food by plants depends upon energy acquired by absorbing light. The materials first used in manufacturing food are water, of which there is a more or less abundant supply wherever plants exist, and carbon dioxide, of which there has been for ages only a very meager proportion in the atmosphere. The supply of carbon dioxide is practically constant, the supply of water variable both locally and generally, the supply of energy, of light, varies daily, varies locally. The process of food manufacture depends, then, upon two variables and one constant, but the constant is very small in proportion to the other ingredients of the air. I wish to emphasize the small proportion of CO_2 in the air, for unless one realizes this, one will fail to understand why plants, by absorbing more of the available solar energy, could not improve their present case. In fact, one criti-

cism of this paper of Stahl's which may be suggested is that he does not appear to take this small proportion into account.

The color of plants is due to the translucent screen of chlorophyll which absorbs the less and the more refractive rays in sunlight, but does not absorb the green and yellow rays in anything like the same proportion. "Hence leaves appear yellowish-green because the greater part of the red, orange, blue and violet are absorbed by the pigments of the chromatophores." Greater absorption would increase the risk of injuring the leaves by overheating. Under present conditions the absorption of energy from direct sunlight exceeds the amount used in food manufacture. If, however, the proportion and the amount of CO_2 available were greater, a larger proportion of the energy absorbed from direct light would doubtless be used, converted into work, in the manufacture of food, and the possibility of overheating would be less. In diffuse light, on the other hand, the available energy is less while the supply of the food materials remains the same. That the energy supply may be disproportionately small is obvious. Stahl sees, therefore, in the chlorophyll pigments a means of absorbing a due proportion of the energy available in diffuse light. He then proceeds to consider the effect of the atmosphere on sunlight, both the absorption of rays of certain sorts and also the diffusion of what remains.

The majority of botanists live in an atmosphere to which, besides the natural addition of water-vapor, unnatural additions are constantly made, namely, smokes and dusts of various kinds. These three additions, water-vapor, smokes and dusts, increase the amounts and somewhat change the proportions of sunlight naturally absorbed by the atmosphere. One need only mentally contrast the atmosphere of Pittsburgh, London and Leipzig with that of Italy, Arizona and California to realize how true this is. The quantity and the quality of the light reaching the earth's surface in these different places is affected accordingly. Natural air absorbs qualitatively and quantitatively less than unnatural air. Stahl claims that plants have adapted their color, their absorbing agents, to light naturally impoverished in its passage through pure air. The color of leaves is due to a mixture of yellow and green pigments, *complementary* to the dominant colors of the lights in nature. The yellow and orange components, consisting mainly of carotin, are complementary to the blue light of the sky; the green components are complementary to the red and orange which impress us as predominant only when the sun is low, early or late, and its light traverses the atmosphere.[1] This is Stahl's main thesis, to which he recurs again and again.

After this study of the relations of the chlorophyll pigments to the composition of ordinary sunlight there follows a discussion of the adaptations of plants, aquatic as well as terrestrial, to the illumination. These adaptations or adjustments are to the physical as well as chemical properties of sunlight, to heating as well as to food manufacture. It is pointed out that the physical effect of intense illumination may consist in overheating the protoplasm itself or in producing excessive evaporation, which Stahl calls transpiration. These are guarded against in a variety of ways interestingly described. The reaction of the chromatophores themselves to various intensities of light is shown, by reference to Stahl's own earlier work and to the work of others, to consist in changes in the position of the chromatophores and in a "regulation" of the quantities and kinds of pigments in them. Thus Stahl describes the changes of shade or color in insolated parts of plants—in the ordinary green land plants, *Fucus* and other brown sea-weeds living between the tide-marks, the green algæ of fresh and salt water, of the surface or below, the peculiar blue-green algæ which live on mud, etc.

Then comes a study of etiolation, the turning white or the remaining white of plants or plant-parts in the dark. This phenomenon has so frequently been the subject of observation and reflection that, each time it is mentioned, it becomes clearer how little is really known

[1] Stahl's words, "durch das *trübe* Medium der Atmosphere," I find myself unable to translate exactly.

about it. Stahl, recording that the seedlings of all gymnosperms except *Gingko, Welwitschia, Cycas* and *Ephedra* are green even when the seeds sprout in the dark, expresses the suspicion that this fact may have phylogenetic significance. It may; but to the reviewer such speculations, such suggestions, savoring more of the study than of the laboratory, are of little use to science. On the other hand, Stahl did not ascertain whether or not there might be differences in the amounts of light reaching the developing embryos in the ripening seeds of these different classes of gymnosperms. He points out earlier in this paper that the seedlings of maple, etc., which are green in darkness, spring from seeds not covered by opaque coats while they are ripening. Thus we do not know that seeds of pine, for example, if made to mature in darkness on the tree, would not yield as colorless seedlings as those of *Gingko, Welwitschia* and the other "living fossils" if similarly sprouted in the dark.

The next chapter is on the autumn yellowing of leaves. Here are recorded or quoted analyses indicating the differences in the content of leaves before and after the autumn change takes place. Thus in equal pieces of the same leaves cut out (by cork-borer) before and after yellowing there is found to be little change in the proportions of magnesium, an increase in calcium, sodium and sulphur, a decrease to one half in nitrogen, phosphorus, potassium, iron, chlorine and silica. The significance of these facts is thus interpreted: the yellow constituents of chlorophyll are composed of elements which are abundant and easily obtained, whereas the green pigments consist of less abundant elements less easily obtained; so, in yellowing or in etiolated parts, the green is withdrawn or is not formed, and there is a corresponding *economy.* Whether one will agree with this conclusion or will dissent from it will depend upon whether one has, as Stahl himself points out, the ecological or the physiological point of view.

Stahl's paper on chlorophyll is a valuable contribution to the subject. It contains many references to the abundant literature; it suggests both further reflection and more work in the laboratory. It is stimulating, perhaps more so because it is not convincing.

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Tuberculosis, a Preventable and Curable Disease, Modern Methods for the Solution of the Tuberculosis Problem. By S. ADOLPHUS KNOPF, M.D. 8vo, pp. 382, with 115 illustrations. New York, Moffat, Yard and Company. 1909. $2.20 by mail.

Dr. Knopf is the author of numerous monographs on medical, sociological and hygienic subjects. The present volume will be welcomed as it deals in a thorough and most satisfactory manner with one of the most important problems of the human race. This was to be expected from the author of the essay "Tuberculosis as a Disease of the Masses, and How to Combat it," which was originally written in German and received the International Prize from the Congress on Tuberculosis held at Berlin, May 24–27, 1899. Dr. Knopf's essay has since appeared in twenty-seven editions and almost as many languages. The book before us is destined to play a very important rôle in the crusade against a disease which carries off more victims than any other human affliction. It is intended by the author to be helpful to the patient, the family, the physician, the sanitarian, to municipal and health authorities, legislators and statesmen, employers and employees, the public press, professors and teachers, clergy, philanthropists, charity organizations and the people at large. Chapters I. and II. deal with what the patient should know concerning the disease, more especially the nature of the disease, the various channels of infection, such as by inhalation, droplet infection, infection from food substances and infection by inoculations; of these the first two are doubtless the most common modes of infection, while the danger from infected food and inoculations can not be entirely ignored. It is well that the author emphasizes the danger from droplet infection. It

was shown a few years ago by Professor Fluegge and his co-workers, that tuberculous patients, in coughing and sneezing and also in speaking, project into the air within a distance of two and one half to three feet small droplets of saliva containing fresh and virulent bacilli, which when inhaled constitute a special source of danger, unless the patient takes care to hold his hand or handkerchief before his mouth. It is held by many, and we believe correctly, that droplet infection is even more dangerous than the inhalation of infected dust. The author describes very lucidly the methods of the four sources of infection and points out that the touch of the clean conscientious consumptive can not give tuberculosis to others. Chapter III. deals with the duties of the physician towards his patient, the family and the community at large. We heartily endorse the opinion of the author that it is wrong, if not a criminal neglect, to hide from an intelligent adult the fact that he is tuberculous or that a member of his family is affected with the disease.

All that is required is tact, and the task of inspiring confidence is not difficult when we can assure our patients that with proper cooperation and treatment over 80 per cent. of cures of incipient cases have been reported. The chapter also contains excellent suggestions for leaflets of instruction, inauguration of general preventive measures, when to send patients away, maxims in the choice of climate, selection of occupation for persons predisposed to tuberculosis, compulsory notification, disinfection of the sick room, the treatment of the patient's mind, etc. The author very properly favors notification of tuberculous cases to the health authorities, so as to locate the sources of infection, to trace and remove the underlying causes of the prevalence of tuberculosis and last but not least resort to disinfection of the premises upon the death or removal of the patient.

The author's twelve maxims on the subject of climatic treatment are sound and should receive careful consideration by physicians and patients. We fully endorse his strong opposition to sending an impecunious patient to a far-away climate in the hope that in a few weeks he may find light employment, when as a matter of fact he is likely to swell the number of inmates of the hospitals and charitable institutions of the far west. Chapter IV. is of special interest, as it tells us in a most instructive manner how the sanatorium may be adapted to and initiated in the home of the consumptive. In view of the fact that over 90 per cent. of our cases are either too poor or otherwise unsuitable for climatic cures, the practical value of this chapter must be apparent. Indeed we are beginning to realize more and more that while certain climatic conditions are valuable as auxiliary factors, our main dependence is after all an abundance of pure air, and a hygienic and dietetic regimen.

Chapter V. tells us in a most interesting manner how sanitation and proper housing conditions may aid in the prevention of tuberculosis. We quite agree with Dr. Knopf that unsanitary dwellings, overcrowding, lack of pure air and sunshine, are most important predisposing factors to the disease.

His views of the effects of polluted air in the cities, workshops and dwellings, and his plea for wide streets and lower buildings, sanitary houses and model tenements, should be heeded, since general sanitation constitutes one of the most effective weapons in the combat against the disease. The present writer has recently studied the general movement of tuberculosis in this country and Great Britain and finds that the death rate from tuberculosis in Washington has fallen from 446 per 100,000 of population in 1880 to 280 in 1907. In New York City from 433 to 271. In the United States at large from 326 to 183. In Great Britain and in Massachusetts the reduction since 1850 amounts to over 50 per cent. These reductions began long before the combat of the disease was a subject for popular education and are coincident with the introduction of sewers, improved water supplies and the erection of sanitary homes. The marked reduction in the prevalence of consumption after the introduction of sewers observed in England and elsewhere may, to a great extent, be

attributed to the prevention of air pollution and dampness. It is noteworthy that while the reduction in the city of Washington coincident with the introduction of sewers amounts to 37.3 per cent., the reduction in Baltimore, an unsewered city, is only 24.7 per cent.

Erismann has calculated that a cesspool with 18 cbm. contents is capable of polluting the atmosphere in the course of twenty-four hours with 18.79 cbm. of impure gases and it requires no great stretch of the imagination to calculate the amount of air pollution which resulted from the cesspools and other makeshifts prior to the introduction of the sewerage system. The relation of dampness to consumption may be explained as follows: Sewers help to drain the soil. Dampness of soil, unless special precautions have been taken, extends by capillary attraction to the walls and renders the entire house damp. Damp air abstracts an undue amount of animal heat, lowers the power of resistance of the inmates and predisposes to catarrhal affections and these in turn render the mucous membranes more vulnerable to the invasion of the tubercle bacilli. There is also reason for believing that the bacilli retain their vitality for a greater length of time in such an atmosphere on account of its humidity and excess of organic matter. At all events it has long been known that tuberculosis is far more prevalent in damp, dark and unsanitary houses. It is difficult to explain how pure water is connected with the deaths other than those from waterborne diseases, yet when we consider that water enters into the composition of the human body to the extent of 60 per cent., we are in a position to appreciate the sanitary acumen of Aristotle when he wrote in his "Politica": "The greatest influence on health is exerted by those things which we most freely and frequently require for our existence, and this is especially true of water and air."

Chapters VI. and VII. deal with the duties of municipal, state and federal health authorities in the prevention of the disease. Dr. Knopf's presentation of what has been accomplished and his many valuable suggestions as to what more needs to be done are of interest and importance. Chapter VIII. enters very fully into the subject of factory and office hygiene—tuberculous employees and servants, general railway sanitation, the farmer's duty in the prevention of tuberculosis in man or beast—and is replete with valuable facts and recommendations. Chapter IX. is one of the most important of the series, dealing as it does with the duties of school teachers, educators and the public press in the combat against tuberculosis. He makes a strong and just plea for school sanitation with special reference to ventilation, lighting and heating, gymnasia, playgrounds and swimming pools and offers many valuable suggestions to those entrusted with the physical development of the nation's most valuable assets. Dr. Knopf offers an alphabet suited for the understanding of younger pupils, in which he points out "the numerous sources of tuberculous infection to which the child may be exposed at school and what the child itself can do to overcome the possible sources of infection." This alphabet should be adopted, as it will prove of immense benefit to the present and future generations, without exciting an undue fear of the disease. The author's description of scrofulous children and those predisposed to the disease, and his plea for open-air schools for such children, should strongly appeal to all educators.

Chapter X. deals with church hygiene, hospitals, cremation, the Emmanuel church movement, value of cooperation in anti-tuberculosis work, need of sanatoria for tuberculous children, sanatoria in the United States and illustrations of different types, social and medical mission of the sanatorium, philanthropic consumptives, day and night camps, class methods, etc. Chapter XI. deals very fully with the duties of the people in the combat of tuberculosis, the early signs of the disease recognizable by the laymen, educational methods by free lectures and literature, overcoming an inherited tuberculous predisposition, hygiene of pregnancy, nursery hygiene, dress and hygiene for children, tight lacing, child labor, alcoholism as a predisposing factor in the disease and its prevention. The author, while a

strong advocate of temperance, is opposed to prohibition and in favor of the Gothenburg system, educational methods and the creation of clean and wholesome amusements calculated to counteract the evil influence of saloons; we heartily endorse his general views on the alcohol question and his opposition to the pernicious system of treating. We regret that Dr. Knopf, an evident believer in home-making, did not emphasize the value of good wholesome food as a preventive factor in alcoholism, especially since the cold dinner pail and badly prepared food create an appetite for alcoholic beverages. In Chapter XII. the author discusses the prospects of the ultimate eradication of tuberculosis and quotes two encouraging sentences from the writings of Pasteur. Dr. Knopf has shown that tuberculosis is a preventable and curable disease—we firmly believe that if the measures recommended by him in his book, and which have been known to sanitarians for some time, were generally adopted, the great "white plague" which now carries off annually over 150,000 victims in the United States alone would be eradicated within one or two generations.

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Scientific Journals and Articles

The Journal of Experimental Zoology, Vol. VII., No. 1 (August, 1909), contains the following papers: "The Production of New Hydranths in Hydra by the Insertion of Small Grafts," by Ethel Nicholson Browne. A stock hydra may regenerate a new hydranth in region of graft if (1) a tentacle with peristome tissue at its base, or (2) just peristome tissue without the tentacle, or (3) regenerating head material, or (4) bud tissue, is grafted in any region except the tentacle region. In the foot region, the new hydranth pinches off as a minute hydra of about one tenth normal size. In and above the middle region, the new hydranth is of normal size. The origin of regenerating material and the fate of absorbed material is shown by grafts of normal green with artificial white hydras. "The Effect of the Destruction of Peripheral Areas on the Differentiation of the Neuroblasts," by M. L. Shorey. The purpose of these experiments was to study the behavior of portions of the developing nervous system when it is itself left quite intact and with all its relations normal, but with the primordia of the organs which it should innervate extirpated before innervation. In every instance it was found that the neuroblasts do not differentiate except in the presence of their normal end organs, or of others of a similar character. "Factors of Form Regulation in *Harenactis attenuata,* II., Aboral Restitution, Heteromorphosis and Polarity," by C. M. Child. In the esophageal region of the actinian *Harenactis* tentacles form at both oral and aboral ends of isolated pieces, but at all levels proximal to the esophagus tentacles appear orally and a foot aborally. The two internal factors determining the polar phenomena are the constitution at the various levels of the body, and the physiological correlations between the parts composing the piece. "Some Effects of External Conditions upon the White Mouse," by Francis B. Sumner. The most important conclusions from these experiments are (1) that certain readily measurable structural modifications have been produced by changes of temperature, corresponding to some of the differences between northern and southern species or varieties of mammals; and (2) that there is a distinct tendency toward the reduction of these experimentally produced differences during subsequent growth, even when the conditions which gave rise to them remain unchanged. "Further Observations of the Behavior of Tubicolous Annelids," by Chas. W. Hargitt. The paper supplements earlier observations and experiments by the author on the behavior of this interesting group of annelids, tabulating in considerable detail the various reactions. It also emphasizes the importance of behavior under natural, as compared with artificial, conditions, and points out the important significance of the complex aspects of the tubes themselves as expressions of behavior. The results fail to show any evidence in support of the so-called tropism theory of behavior.